

(English Version)

Instructions :

- (i) First 15 minutes are allotted for the candidates to read the question paper.
- (ii) All the questions are compulsory.
- (iii) This question paper consists of **five** Sections — Section A, Section B, Section C, Section D and Section E.
- (iv) **Section A** is of multiple choice type and each question carries 1 mark.
- (v) **Section B** is of very short-answer type and each question carries 1 mark.
- (vi) **Section C** is of short-answer type-I and each question carries 2 marks.
- (vii) **Section D** is of short-answer type-II and each question carries 3 marks.
- (viii) **Section E** is of long-answer type. Each question carries 5 marks. All four questions of this section have been given internal choice. You have to do only one question from the choice given in the question.
- (ix) The symbols used in the question paper have usual meaning.

Section A

1. (a) Resistivity of a conductor depends on its: 1
 - (i) length (ii) thickness
 - (iii) material (iv) None of these
- (b) Electric and magnetic field vectors of an electromagnetic wave are $\vec{E}$ and $\vec{B}$, respectively. The direction of propagation of the wave will be represented by: 1
 - (i) $\vec{E} \cdot \vec{B}$ (ii) $\vec{E} \times \vec{B}$
 - (iii) $|\vec{E}| |\vec{B}|$ (iv) All of these
- (c) Unit positive charge experiences same force at each point of an electric field. The electric field will be: 1
 - (i) uniform (ii) non-uniform
 - (iii) variable (iv) can say nothing
- (d) Mass defect in a nuclear reaction is 1.2 gram. Energy released in the reaction will be: 1
 - (i) 1.08×10^{17} J (ii) 3.6×10^{16} J
 - (iii) 3.6×10^{12} J (iv) 1.08×10^{14} J
- (e) Momentum of a photon is: 1
 - (i) $\frac{h\nu}{c^2}$ (ii) $h\nu$
 - (iii) $\frac{h\nu}{c}$ (iv) $\frac{\lambda}{h}$

- (f) A charge of 20 coulomb is moving in a magnetic field of 3×10^3 tesla. Work done by the magnetic field on the charge will be :

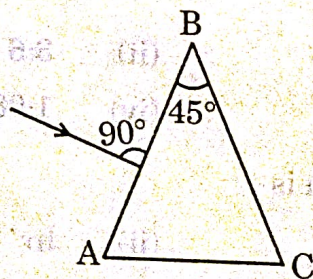
- (i) 6×10^3 J (ii) 0
(iii) 6.6×10^3 J (iv) 6.2×10^3 J

Section B

2. (a) An object is placed on the axis of a concave mirror, somewhere between the focus and pole of the mirror. Compare the size of the object and the image using ray diagram. 1
- (b) The threshold frequency for a photosensitive surface is 8×10^{14} Hz. Find the work function for the surface. 1
- (c) Which substance has maximum binding energy per nucleon and how much ? 1
- (d) What is meant by 1 watt of power in an electrical circuit ? 1
- (e) What is the meaning of a uniform magnetic field ? Explain with help of suitable sketch. 1
- (f) In an alternating circuit, readings of voltmeter and ammeter are 220 V and 1.4 A, respectively. Find the root mean square (rms) values of voltage and current. 1

Section C

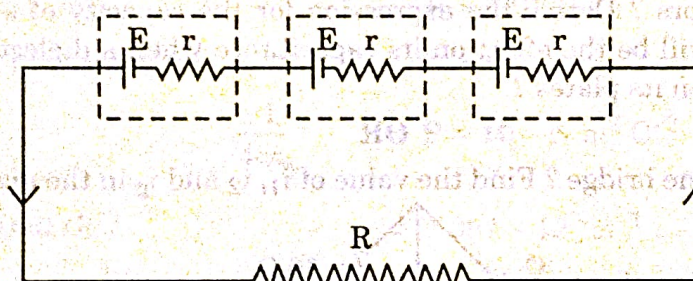
3. (a) Find the expression for the electric potential at a point on the axial line of an electric dipole, produced due to the dipole. 2
- (b) State the working principle of a transformer and mention two losses occurring in a transformer. 2
- (c) Show the emergent ray corresponding to incident ray on a prism, as shown in the figure. If critical angle for prism material is 45° , what will be refractive index of prism material ? 2



- (d) Define electric flux. What is the meaning of positive and negative flux ? 2

Section D

4. (a) Two waves of intensity I_1 and I_2 are propagating in a given region of space. Intensity of light is $(I_1 + I_2)$ everywhere in the region. Are the waves coherent and is interference occurring between them? What will be the value of resultant maximum and minimum intensities if both waves are coherent? 3
- (b) Mention the conclusions of Rutherford's α -particle scattering experiment. α -particle of kinetic energy 100 eV is scattered by a nucleus (atomic number 70). To which extent may particle approach the nucleus? 3
- (c) State Gauss's theorem in electrostatics. Find the electric field intensity near an infinity charged plate conductor. 3
- (d) What is the nature of electromagnetic waves? An electromagnetic wave is polarized parallel to the direction of $\vec{X}$. What will be the direction of the propagation of the wave? The amplitude of electric field of electromagnetic wave is 120 Newtons/Coulomb and frequency is 50 MHz. Find the equation for the electric field ($\vec{E}$). 3
- (e) Explain the dependency of the photoelectric current and energy of photoelectrons on the intensity and frequency of the incident light. 3
5. (a) Give qualitative explanation of the effect of temperature on the resistance of a conductor. Find the value of current in the given circuit. What will be the maximum value of the current? 3



- (b) State Biot-Savart law for the magnetic field produced due to a current element. Current element $\Delta x \hat{i}$ is at the origin. Current of 10 A is flowing in the element. What will be magnitude of the magnetic field produced by the element at a point at a distance of 0.5 m on the y-axis? (Given $\Delta x = 1$ cm) 3
- (c) In general what is object of doping of intrinsic semiconductors? Draw relevant circuit diagram for obtaining characteristics of a p-n junction diode in forward and reverse bias condition. 3

OR

Explain the phenomenon of self-induction and mutual induction. Mention the units of self-inductance and mutual inductance. 3

(d) When is emission and absorption spectrum of hydrogen observed ? Explain on the basis of energy level diagram for hydrogen atom. 3

(e) Explain de Broglie's postulates for matter waves. Kinetic energy of a neutron is 6.7×10^{-21} joules. What will be the wavelength of de Broglie waves associated with it ? 3

Section E

6. State and prove Ampere's circuital law. Using this, find the expression for the magnetic field produced due to an infinitely long current carrying conducting wire. 5

OR

What is the resistance of an ideal p-n junction diode in forward and reverse biasing ? Draw circuit diagram of a half-wave diode rectifier and discuss its working. 5

7. What is a solenoid ? Show the magnetic field lines produced by a current carrying solenoid. Length of a solenoid is 80 cm and 2000 turns are in it. Current in the solenoid is 10 amperes. Find the magnitude of magnetic field inside the solenoid near its centre. 5

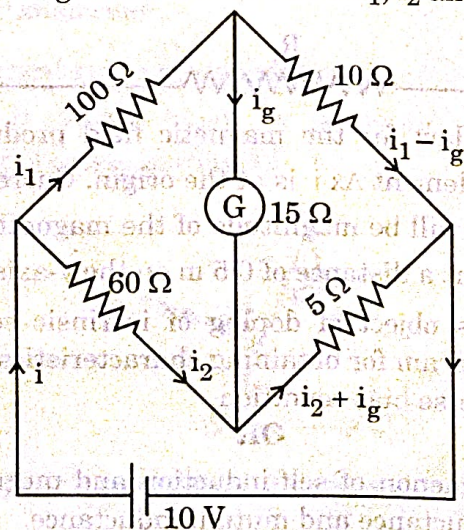
OR

Derive the formula for refraction of light through a concave spherical surface. A glass sphere of radius 5 cm is situated in air. An air bubble is 2.0 cm away from the centre of the sphere. How far will the bubble appear when seen through the surface nearer to the bubble ? (Refractive index of glass is 1.5) 5

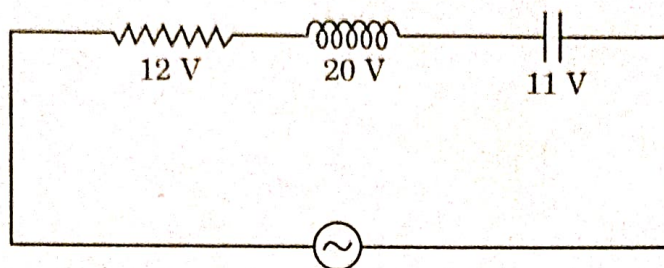
8. What are capacitors ? Derive the expression for the capacity of a parallel plate capacitor. What will be the effect on its capacitance when a dielectric material is introduced between its plates ? 5

OR

What is Wheatstone bridge ? Find the value of i_1 , i_2 and i_g in the given circuit. 5



9. In an alternating circuit, L, C and R are connected in series. Give (i) impedance (ii) phase difference between voltage and current (iii) nature of impedance at resonance; in the given circuit, find the voltage (rms) of the source and the phase difference between the voltage and the current. 5



OR

Explain the polarisation of light. Explain why the phenomenon of polarisation (i) is possible in light waves, but (ii) not possible in sound waves. Write two applications of polaroid. 5

Physical constants :

Planck's constant (h)	=	$6.6 \times 10^{-34} \text{ J-s}$
Charge on electron (e)	=	$1.6 \times 10^{-19} \text{ C}$
Mass of electron (m_e)	=	$9.1 \times 10^{-31} \text{ kg}$
Speed of light in vacuum (c)	=	$3 \times 10^8 \text{ ms}^{-1}$
	$\frac{1}{4\pi\epsilon_0}$	= $9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$
Rydberg constant (R)	=	$1.097 \times 10^7 \text{ m}^{-1}$
	μ_0	= $4\pi \times 10^{-7} \text{ NA}^{-2}$
Mass of neutron	=	$1.6 \times 10^{-27} \text{ kg}$
1 eV	=	$1.6 \times 10^{-19} \text{ J}$